

AMERICAN GEOPHYSICAL UNION  
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Transcript of Remarks by  
DANIEL S. GOLDIN  
Administrator  
National Aeronautics and Space Administration

Thank you for that wonderful introduction.

When my daughters were very young, I gave a talk at their elementary school and I spoke about the solar system and I started to describe the Earth and how it spins about its axis. And why there was day and night. I talked about the various planets, about Mars and Venus. And I tried to tell them about the outermost planet of the solar system, Pluto. And I even described to them that there might be something beyond that planet. And there were very, very happy faces in the room.

And then I began speaking about the Sun, and I told them about the Sun and how it provides energy to the planet. And I made a mistake. I told them the Sun was going to burn out in about 5 billion years. They were absolutely appalled, they were frightened. And their main worry was, what's going to happen to me. (Laughter).

And these fears don't leave us as we grow older, they just become much more sophisticated. Let me tell you a story that Charlie Kennel just told me a few days ago. And he said he was stuck in traffic in Paris with a very, very famous academician and they were talking about cosmology. And Charlie described recent observations bearing on the fate of the universe, which depended upon the density of matter.

If the density is too high, the universe will collapse. If it's just right, it will neutrally expand. But if the then new observations were correct, the density would have been so low that the universe would just expand forever and die. Charlie's companion was aghast. In a flash he saw not just his own mortality, but the mortality of the whole human race. And he blurted out, "That's intolerable."

This anxiety, this fear, is not a bad thing: it reflects our urge to survive. In the past, has led us to explore new continents, to find new places where people might live and prosper, to find new methods of producing food and fuel, to create new ideas and new technologies.

Today, we fear global economic competition, ethnic strife, environmental degradation and an ever increasing population on this very small planet. We are becoming a global society, and we realize we need a transformation--human, and social, and technological. All three are required in order to survive.

NASA has an especially important role to play in protecting our planet. People are worried about global warming, changes in the ozone layer, deforestation, loss of biodiversity, and air and water quality. This is the reason for NASA's "Mission to Planet Earth," which is one way NASA will help accomplish the larger transformation.

Another way NASA may play a role in achieving this transformation is by helping to answer questions, the new questions we now face.

The old question was, "How can we beat the Soviet Union?" That has been replaced with a new question, "How can we all live together on our small planet?"

The Space Station, first conceived as a symbol of dominance, not is a symbol of our new yearning to live in harmony with other nations. It may turn out to be not only a testbed for technology, but for learning how we can work together with other nations on an incredibly complex technological venture.

Relevance must be at the heart of what we do--using the resources of space, and the technologies we develop to get there and operate--to better the lives of all people in our nation and the world.

In the ancient past, one of the reasons astronomers sought to map out the heavens and learn about the season was to improve agricultural production and planning. What they did was relevant to their people's needs in ancient times, and those people understood that. There was a direct connection.

In the recent past there was also a direct connection between the space program and the American people's needs. For decades, the space program perfectly filled America's need to beat the Soviet Union, to demonstrate our technological superiority over the Evil Empire.

When Soviet cosmonaut Yuri Gagarin became the first human being to orbit the Earth in 1961, we decided we had to beat the Soviets to the Moon. That is how we were going to prove to ourselves and to the world that we were more technologically adept than the Soviets. The space program had a purpose. It had a mission. And throughout the Cold War, it had tremendous support from the American people. They were able to make that direct connect.

Then the Berlin Wall came down and before our eyes, an old era crumbled. What is this new era emerging? We don't know yet. We are struggling to define ourselves and redefine our science and space policies when we head into an uncertain new age. And we are struggling to make a transformation from a space program that for 35 years was a projection of power to one that is relevant to human needs in the 21st century.

There is uncertainty today over how to do that. Scientists are uncertain. NASA and contractors are uncertain. Congress is uncertain. The American people are uncertain. That's okay. It really couldn't be any other way. Those that cry for clarity in the midst of chaos are asking for a formula for disaster. It will take time to think this through. We cannot expect this instant clarity as we leave the Cold War behind and we turn slowly toward the new millennium.

But we need to begin working toward a unifying vision for the space program--an integrating goal that will define our purpose. And a purpose that will strike a chord in the hearts and minds of Americans. It won't happen over night. It will take time, thought, and imagination.

The AGU and NASA have partnered through the years of the space program. On your 75th anniversary, we stand here with you to face the challenges of a new time together.

I really hope you will think about where we will be when the AGU celebrates its 100th anniversary. We in NASA are ready to start exploring that vision. We are ready to start reaching out--to our partner, the AGU, and other science groups, the universities, government leaders and the public to start discussions of a common vision for space.

NASA is getting its house in order, and we will soon be ready to look outward once again. We are reinventing ourselves, and we are doing what we say we will do.

We absorbed a 30% budget cut in the last 12 months because the president and Congress asked us to step up to the challenge of today's tough times. We want to be part of the solution, not the problem, and America has enormous depth. We're middle aged and it's time that we get more efficient. The American public wants less in and more out, and we're proud to step up to the cuts that we've just had. Even though our budget has come down, we have started new programs--the Mars Surveyor, Mars Pathfinder, the Small Sat program, the Relativity Mission and NEAR. These programs will take two or three years to develop, not two or three decades, and cost tens or hundreds of millions of dollars, and not billions. No one needs spend their entire career on this program. We're going to try to get our programs within the timeframe to obtain a Ph.D., not to have to grow old and gray.

And we firmly started a number of large missions that were in the planning stages: AXAF, Cassini, and EOS. And we made difficult decisions about how to spend our precious resources. We've brought a new accountability to NASA, instituted contract reforms, and created a Program Management Council to keep our programs on track, hold them to cost and detect problems early. And when they overrun, we cancel them. The American public expects no less. The NASA contractors and scientists are going to have to learn vision to perform and not vision to win.

We redesigned the Space Station at the request of President Clinton. We have a safer, cheaper Station that does more robust science, and does it sooner. And we brought the Russians aboard as partners, also at the request of the President.

We committed a year before-hand to repair the Hubble Telescope in December '93, and we did it. Spacecraft is now producing spectacular results. One need only look at today's Washington Post and the press conference of yesterday. Shortly after I arrived at NASA, we committed to a launch date for GOES-8 for April 1994, and we did that, too, despite all the delays and problems that had occurred earlier. GOES is now in final checkout on orbit, and if all goes well, we intend to turn it over NOAA as a fully operationally system, and America will no longer have to rent spacecraft from the Europeans, but will work together with them on joint systems to benefit people from both countries.

We are a leaner, more efficient NASA. We have reduced the cost of the Earth Observing System by more than a factor of two. We are proposing to fly five missions to Mars for about the cost of one Mars Observer. We plan to accomplish the objectives of the SIRTf mission for about one-quarter of the cost projected just a few years ago. And we have brought down the cost of SOFIA by a factor of two and we hope that we'll be able to start that in the not too distant future.

We are planning the Fire and Ice Mission with the Russians to go to the Sun and to Pluto. And we propose to do it for about one-third of the price projected only two years ago. All quality science. We have just released an announcement of opportunity for small science mission that go from design through operations and launch for \$8-12 million for less. Thank you, Paul Coleman.

We are reshaping the Agency. If we hold steady on the course for the next 10 years or so, we will be in a position to embark on a new direction for our space activities.

It is not too soon to begin thinking about that direction might be. When the women and men of the AGU come together to celebrate their hundredth anniversary, what will the space program be doing? What is our next step going to be?

We might send humans to Mars to search for signs of ancient life or to establish their subsurface water. We might go back to the Moon, or visit a nearby asteroid. We might develop space commercially through industry-government partnerships. We might do all those things and more or less.

But today, I want to sketch out a different possibility just to get the thinking going. I want to raise questions. I want to begin a dialogue between NASA and the science community that will forge a new vision that connects NASA and the American people. So we don't have to describe a multiplicity of programs and a multiplicity of disciplines, but we could have common vision and endpoint in mind so we could determine the path.

We will develop the shared vision that all Americans can understand, and one that responds to their hopes and dreams. Even if we can't get started on it for a decade or two, it could chart a path to the future.

So here goes. Has the public fascination with planetary exploration fallen off because people don't see a place for themselves in the solar system? Right now, from our limited knowledge to date, we expect that our solar system is too harsh, that without massive intervention we cannot sustain human life. I wonder.

Since human beings first walked on the Earth, they have gazed up to the sky and wondered if there is life out there. Today, you can go to Australia, and I did, and talk to the Aborigines. They do look up to the sky and they wonder. Americans don't do that much anymore, especially since we've grown up in cities, surrounded by noise and traffic and pollution. We're really isolated from the cosmos and nature.

If you go out into the country, and look into the heavens, and go to the top of a mountain, there is no pollution or background light. The stars glitter, the moon is luminous, and the sky is eerie and magical.

Every woman and man has a desire to know that wonder. To reach beyond themselves and seek answers to the questions about the universe and their place in it. When was the last time you looked at the stars. Not in a textbook or a viewgraph, but went outside and came into contact with the cosmos and the concept of infinity in time and space on a personal level, a crossover between cosmology and theology.

What if, while protecting the precious resources on our own planet, exploring our own solar system, we also commit to study the universe with powerful observatories. I'm not sure whether they go on the Moon or Earth orbit or some

near solar orbit, but what if we used these new powerful observatories to seek and discover planets around nearby stars.

Wouldn't the very knowledge of their existence transform our understanding of our place in life, of our place in the universe? Provide hope? Should we set our sights on finding out whether there is a nurturing environment beyond our solar system?

There are thousands of stars within tens of light years from the Earth. And many planetary scientists now believe that planetary systems are common and we know life did start on a hostile environment in early Earth. So it is not out of the question that nearby stars might have planets capable of sustaining life.

In the not too distant future, we will have the technology needed to image any planets that might orbit nearby stars. It may be possible to infer through spectroscopic analysis of their atmospheres or the colors of their oceans whether they are life-bearing or not. Whether there is equilibrium in the environment for oxygen or not. What a revelation that would be. That would change everything--no human endeavor or human thought would be untouched by that discovery.

I have one slide. You need to have some imagination. Could you turn that slide on, please. Turn down the lights a minute, let's have an experience. Think of the possibilities. Technology will get here, don't worry. Just look at that slide and think about what might happen if the scientists at the 100th anniversary of the AGU put that up on the screen and had the analysis with it. That one single picture. But let's say that picture was not of planet Earth. How do you think it might impact how every single person on this planet thinks about themselves. Think about it.

I'm done with my slide. If we could have the lights?

Every society leaves behind a legacy. The ancient Greeks produced art, philosophy, and the beginnings of theoretical science. The Egyptians build the pyramids of Giza. The Romans laid 50,000 miles of highway. And the Mayans built observatories to map the stars.

Perhaps, just perhaps, the next generation's legacy will be an image of a planet 30 light years from Earth--and the tools of technology it took to capture that image, all combined in one gift to our children, 25 years from now. Or perhaps it will be something else, something we haven't even dreamed of yet. We have to get ready scientifically fairly soon. We would have to establish a technological foundation for imaging other solar systems--developing the needed telescopes and interferometers and other instrumentation.

The remote sensing observations made by our planetary mission by Earth Observing Systems would help in designing instruments needed to observe the planets around other stars--make a ground truth, if you will, for interpreting results.

In fact, we need to focus all of our space sciences on the problem, starting with understanding how stars were formed and how proto-planetary disks of dust and gas are formed around young stars.

We would need to understand how planets are formed from this dust and gas, what they would be like and how they would evolve.

And we need to understand how a habitable planetary environment can evolve and be sustained, and be shielded from injurious stellar radiation and plasma particles around such planets.

The search for life-sustaining worlds could be a new unifying goal for space research. It's one possibility--by no means the only one or necessarily the right one. What is clear is that we need goals like this that can integrate the space sciences into a simple statement that the American public can understand and give us a path to go down. When we went to the Moon and we had Apollo. We did unbelievable planetary sciences, we did unbelievable space physics, and got started on space astrophysics. The American public understood. And all I'm saying is there needs to be an integrating theme. Not a set of disciplines that perform a set of entitlements, but an integrated theme that asks basic questions. I have asked the newly formed NASA Science Council to start articulating a vision for the role of space science in America. And I mean all the sciences--Earth, Life, Microgravity, Planetary, Fundamental Physics and Astrophysics.

I have asked the Council to address the changing role of space science in America, its priorities and how it reaches out to the nation, how well it communicates with the American public. I've asked it to set goals not only for cutting-edge science and exploration, but for the human values of leadership, teamwork, productivity and integrity.

And I invite you to join us as we turn to the future. I'm not making a specific proposal today. I'm starting a discussion with the science community. For any vision to be worthwhile, it must be a shared one.

We can step up to the challenge. We have done so in the past and we will do so again. Look how far we have progressed towards our hypothetical goal of discovering life-sustaining planets since the 25th anniversary of the AGU--1944.

The first breakthrough was the Hale Telescope which began from Palomar Mountain in 1949. When I was growing up, Palomar Mountain was the temple

of astronomy and astrophysics. And in those days, we could only afford one big mirror for a generation. And now we have no problems building many of them.

The next breakthrough was Sputnik. The ability to rise above the atmosphere opened up a whole new world for many sciences. We gained the ability to go out and take samples from other worlds. The samples we brought back from the Moon changed our understanding of the Moon's origin and geologic history. They are still giving us data that no amount of remote sensing and mapping could supply.

The fourth major breakthrough was our ability to do *in situ* measurements on other planetary bodies, like Mars and Viking. And the fifth was the capability for a new technology here on Earth, like adaptive optics and large mirrors. And hopefully, non-linear optics.

Some of the things NASA hopes to do in the near future will contribute to this goal. The Solar-Terrestrial Probe series is planned to study the plasma and magnetic environment that couples the sun and the Earth. We hope SOFIA and SIRTf will make new observations--observations of stellar and planetary formation processes. We have to go to the edge of the solar system to Pluto, and go back to Mars, and get clues from asteroids, comets and other planetary bodies about the origin and evolution of the solar system. However, these will not be billion dollar missions. They have to be small, fast, and we have to get them off in two to three years. Not two to three decades. We can do it because the technology is here.

And a decade from now, we hope to have gone through the whole of the solar system to find the Sun-Earth connection, and completed the survey of the universe across most of the electromagnetic system. We would indeed, at that point in time, be ready for the next step. Just take that picture that I just showed you, that one picture could make a difference.

There's a story about Lord Kelvin and it illustrates how he felt about making that vision come true. His gardener was complaining about an order to start planting trees the next day. Kelvin listened, and then said, "How long will it take these trees to mature?" The gardener replied, "About 30 years. So why are you in such a hurry?" Kelvin responded, "Thirty years?" Then there's no time to waste. By all means, let's start planting today!"

Let us begin. Let us begin planning today the difficult, daring, breathtaking feat that's going to be the talk of the AGU conference on its 100th anniversary. It could be that picture I just showed you. It doesn't necessarily have to be, but it could be. And let us here today in this room, define the reasons that 25 years from now, those women and men will sit hushed, looking at an image of a world never seen before. Or listening to an astronaut describe her feelings when she



touched down on the red dirt of Mars. Or a scientist describing the possibilities for sustaining human life on another planet. The choice is ours. We could do it. But when we do it and when we start it, let's not have a 30-year mission. At that point, a decade or two from now, let's make sure that mission is no more than eight years and a small fraction of what we spend on the big missions now.

We are opening up that discussion today. We need you to be part of something that's just beginning at NASA. We've got a new team in place, and a funny thing is starting to happen. In the Administrator's suite, we're not just talking about budgets and fiscal cycles and contract reform. We're talking about the future again. We're talking about working toward a vision that will integrate the space program, and give it the power and resonance to unify America once again, as we step out into the first light of a dawning age.

Thank you very much.